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NASA-16345 (MARCH 2001)  
NATIONAL AERONAUTICS NASA  
AND SPACE ADMINISTRATION SUPERSEDING NASA-16345  
(SEPTEMBER 1999)  
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DIVISION 16 - ELECTRICAL

SECTION 16345

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03/01

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SECTION 16345

MOTOR CONTROL  
03/01

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NOTE: Delete, revise, or add to the text in this  
section to cover project requirements. Notes are  
for designer information and will not appear in the  
final project specification.

This section covers motor-control centers for the  
grouped control of motors. Also include Section  
16286, "Overcurrent Protective Devices." Drawings  
must show complete single-line diagrams, elevations,  
control diagrams or schematics, bus ratings, and  
short-circuit ratings.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be  
manually edited except to add new references.  
References not used in the text will automatically  
be deleted from this section of the project  
specification.

\*\*\*\*\*

The publications listed below form a part of this section to the extent  
referenced:

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control Devices and  
Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 845 (1995; 4th Ed; Aug 1, 1989) UL Standard

## for Safety Motor Control Centers

### 1.2 GENERAL REQUIREMENTS

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NOTE: If Section 16003, "General Electrical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.  
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Section 16003, "General Electrical Provisions," applies to work specified in this section.

Connection Drawings shall be submitted showing the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Certificates shall be submitted for circuit tests on similar motor-control or motor-circuit protector (MCP) units under actual conditions may be submitted in lieu of factory tests on the actual units provided.

### 1.3 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.  
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The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

#### SD-02 Shop Drawings

Connection Drawings shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Installation drawings shall also be submitted for the following items in accordance with the paragraph entitled, "Installation," of this section.

Motor Control Units  
Protective Devices

#### SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Motor-Control Centers  
Motor Control Units

#### SD-07 Certificates

Certificates shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

#### SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for the following including special provisions required to install equipment components and system packages. Special notices shall detail hazards and safety precautions.

Motor Control Units  
Protective Devices

### 1.4 SHIPPING

Motor-control centers longer than 8 feet 2400 millimeter shall be shipped in coordinated subassemblies for field connection. Maximum shipping length shall be as approved.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

Motor-control centers shall conform to NEMA ICS 2, UL 845 and NFPA 70.

### 2.2 CONFIGURATION

Motor-control centers shall be NEMA ICS 2, Class I, Type B, totally enclosed, free-standing, dead-front distribution type with one or more vertical sections in which combination motor-control units, transformers, panels, and associated control equipment units are group-mounted in an integrated assembly.

### 2.3 CONSTRUCTION

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NOTE: Access is required to inspect the motor control center while circuits are energized (for example, using infrared imaging). Minimum distances to energized circuits is specified in OSHA Standards Part 1910.333 (Electrical - Safety-Related work practices). OSHA Standards are available on the internet.  
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Motor-control centers shall be accessible from the front and rear.

Provisions shall be made for leveling the entire assembled motor-control center sections and bolting them together so that they form a contiguous structural enclosure.

Motor-control centers shall contain electrical interlocks, unit control terminal blocks, master control terminal blocks, unit wiring to terminal blocks and unit interconnections, and power connection terminal blocks as required.

Covers for motor-control centers shall be fabricated from cold-rolled carbon-steel sheets of commercial quality with stretcher-level flatness. Vertical sections shall be reinforced to form a rigid structure.

Lifting angles shall be 7 gage 5.0 millimeter thick, and shall be provided on the top of each section, and shall extend the entire width of the section, and shall be capable of supporting the entire weight of the motor-control center section without distortion. Base channels shall be provided with holes to facilitate floor mounting and leveling.

Design of the motor-control centers shall allow addition of sections with the same height and width without major modifications. Top cover shall not sag or be deformed.

Top and sides shall have removable covers secured with bolts or fasteners. Covers shall permit access from the rear to the main bus and bus-tap connections in each vertical section. Access doors to motor-control drawout units, wiring channels, and the protective cover of the main horizontal bus shall provide dead front construction.

Horizontal wiring channels shall be provided in the top and bottom of motor-control centers for wiring between vertical sections. Wiring channels shall extend the entire length of the motor-control center and shall allow space for duct and conduit entrances. Vertical wiring channels shall be provided in each vertical section for side wiring to individual motor-control units. Vertical wiring channels shall extend the entire length of each vertical section. Covers of motor-control units and vertical wiring channels shall be side-hinged to the vertical section and fastened in the closed position with captive bolts, screws, or latches. Horizontal wiring channels shall be removable and fastened in place with captive bolts or screws. A removable steel-plate barrier shall be provided at the top of each vertical structure to isolate the main horizontal bus from the horizontal wireway.

Horizontal bus structure shall extend the entire length of the motor-control center and shall be tinned copper with a continuous rating of [600] [1200] amperes.

All vertical sections shall be completely bused (600-ampere rating) and electrically interconnected with [tin] [silver]-plated solid copper busbars to accommodate plug-in starter units with main horizontal and vertical buses uniformly positioned and phase sequenced. Main horizontal buses shall be readily accessible for connection of future vertical sections at

either end.

Vertical sections shall have a width not less than [15] [20] inches [380] [510] millimeter.

Buses shall be supported and braced to withstand the short-circuit currents indicated. Contact surfaces of main buses shall be silver plated and bolted together to ensure conductivity.

Main incoming lug compartments shall be provided.

A continuous rigid tin-plated copper ground bus shall extend through the bottom of the entire assembly and shall ground the stationary structure and equipment. Ground bus shall be capable of carrying the rated short-circuit current available in the motor-control center.

After fabrication, steel surfaces of motor-control centers shall be cleaned and phosphatized prior to the application of paint. External and internal surfaces shall be finished with baked enamel or a fast air-drying enamel. [Color of internal and external finishes shall be the manufacturer's standard.] Nonpainted parts shall be cadmium plated or coated with zinc chromate.

## 2.4 COMBINATION MOTOR-CONTROL UNITS

Combination motor-control units for the control and protection of single-and three-phase, 60-hertz squirrel-cage induction motors with branch-circuit disconnection and protective devices shall include magnetic motor-controllers, molded-case circuit breakers, or motor-control circuit protectors in compartmentalized draw-out unit construction with fused control-power transformers, selector switches, pushbuttons, and indicating lights, as indicated. Motor control and protective devices shall conform to the requirements of Section 16286, "Overcurrent Protective Devices."

Unit spaces in vertical sections shall be provided with guide rails for the support and alignment of motor-control draw-out units. Latches shall be provided to ensure complete electrical connection of the draw-out unit with the main bus and to allow removal of the draw-out unit from the motor-control center. Plug-in units shall be interchangeable.

Draw-out unit shall be provided with spring-loaded, silver-plated, plug-in stabs for connection to the main bus on the line side of the motor-control unit and fixed terminal blocks for the load-side connections. Wiring shall be accessible from the front. No wiring shall extend into the bus compartment. Unit terminal blocks shall be the split type, allowing unit removal without disturbing outgoing wires.

Motor-control units shall be provided with a single separate hinged door interlocked with its associated disconnecting device to prevent access to draw-out units when the circuit breaker contacts are closed and the operating handle is in the "ON" position. Doors shall swing open a minimum of 112 degrees. An interlock release shall be provided, however, to defeat the interlocking mechanism and permit access to the draw-out unit using a simple hand tool.

Doors shall be provided with openings for the operating handle of molded-case circuit breakers, thermal-overload relay reset buttons, indicating lights, selector switches, and pushbuttons as required.

Disconnect switch overload reset button, selector switches, and any indicating lights and pushbuttons shall be operable with the compartment door closed. The ON-OFF position of the main disconnect method shall be clearly indicated with the door closed.

Feeder tap units shall include externally operable molded-case circuit breakers in combination motor-control unit enclosures for the protection of non-motor loads or remotely located magnetic motor-controllers. Not more than two molded-case circuit breakers shall be contained in feeder tap units.

Compartments for future combination motor-control units shall be complete with hardware, buses, and hinged doors ready to receive future draw-out units. Compartments for spare combination motor-control units shall be complete with buses, hinged doors, and draw-out units but without load terminal connections. Spare spaces shall be complete with buses and screwed-on front cover plates.

Combination motor-control units shall be identified with identification plates affixed to the front hinged door or cover plate of each compartment. Identification plate shall identify the connected load.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Complete assembly shall be electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be aligned, leveled, and secured to the supporting construction in accordance with the manufacturer's recommendations.

### 3.2 FIELD TESTING

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**NOTE: Select site tests for motor-control centers  
from the following paragraphs to suit the project  
requirements.**  
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Motor-control centers shall be subjected to continuity and insulation tests after the installation has been completed and before the motor-control center is energized.

Contractor shall provide test equipment, labor, and personnel to perform the tests required. Continuity tests shall be conducted using a dc device with bell or buzzer.

Motor-control centers shall be completely isolated from extraneous

electrical connections. Substation feeder breakers, circuit breakers in switchboards, and other disconnecting devices shall be used to isolate the motor-control center under test.

Insulation tests on 600-volt motor-control centers shall be conducted using a 1,000-volt insulation-resistance test set. Readings shall be recorded every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Insulation tests on motor-control centers 480 volts or less shall be conducted using a 500-volt insulation-resistance test set. Readings shall be recorded every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Prior to final acceptance the motor control center shall be energized and loaded (to the maximum load possible, but not less than 10 percent of expected full load) for a minimum of 10 minutes and the temperature measured, with a non-contact device, to verify connection integrity. The temperature detector shall be accurate within 0.5 degrees C. Each phase temperature of 3 phase circuits and individual connections compared to other similarly loaded connections shall be within 3 degrees C of each other. Temperatures outside these values warrant investigation.

Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to motors and other connected equipment shall be clockwise.

Test data shall be recorded and shall include location and identification of motor-control centers and megohm readings versus time.

Final acceptance shall depend upon the satisfactory performance of the motor-control centers under test. No motor-control center shall be energized until recorded test data have been approved by the Contracting Officer. Final test reports shall be provided to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --